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ScienceDirect

Energy Procedia 5 (2011) 664–668

Energy Procedia

IACEED2010

Current Situation and Countermeasures of Energy-saving Buildings in Wuhan City Circle

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Abstract

This paper starts from the importance of energy-saving buildings and the current situation and countermeasures of energy-saving buildings in Wuhan city circle during the "eleventh five-year" period. Then point out the treatment of energy-saving buildings should combine several aspects during the "twelfth five-year" period, such as architectural design, construction, development and application of energy-saving technologies and building energy management, and make the Wuhan city circle truly green building pilot demonstration area.

Keywords: energy-saving buildings; wall reform; low energy consumption of architectural windows and doors; roof insulation and heat insulation

1. Introduction

In the International Climate Conference in Copenhagen, Chinese government put forward specific greenhouse gas reduction targets by 2020, gross domestic product (GDP) of carbon dioxide emissions below 2005 levels by 40% -45%, and as binding targets into national economic and social development long-term planning. Construction ministry and construction department of housing and urban signed framework agreement between province and department, and make Wuhan city circle truly green building pilot demonstration area. Wuhan Municipal Government will be the development of green building as the breakthrough of "resource-saving and environment-friendly" social construction in the construction field. China's current total construction areas cover more than 400 million square meters. In 2009, the new construction areas cover about 2.2 billion square meters. With the development of urbanization, China’s

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doi:10.1016/j.egypro.2011.03.117

construction areas expect to add about 30 billion square meters floor area in 2020. Among China's final energy consumption, the total building energy consumption accounts for about three percent of total energy consumption. If the situation allowed continuing to develop, then by 2020, China's building energy consumption will reach 108.9 billion tons of standard coal. Only summer air-conditioning energy consumption needs ten Three Gorges power plant to meet[1]. Only 10% to 15% of China's new construction can reach the national mandatory energy efficiency standards, and more than 80% for high energy consumers created a heavy social burden and serious environmental energy pollution and hampered China's sustainable development[2].

2. Energy-efficient buildings' current situation in Wuhan during the "eleventh five-year" period

During the "eleventh five-year" period, the implementation rate of Wuhan's building energy efficiency standards increases year by year, and establish building energy conservation regulations, technical standards system and administrative control system. If implement strictly the building energy efficiency design standards, the implementation rate of Wuhan's new building energy efficiency standards can reach 100%. From 2010, the Wuhan city will implement "Wuhan city circle low-power design standard for residential buildings". At present, Wuhan is committed to the application and development of renewable energy in new buildings. By the end of 2009, the application areas of solar hot water systems and ground source heat pump up to 2 million square meters. In 2009, Wuhan city was approved as the demonstration city of renewable energy building's applications. In 2010, the application areas will reach 500 million square meters. Wuhan built 230,000 square meters of green building in 2008, and launched 13 green building pilot projects, with a total construction area of 1,607,900 square meters. For example, Kindu Palace locates in JiYu Bridge district, Wuchang, and covers nearly 160 mu, and the volume rate is 2.18, and the total construction area is nearly 30 million square meters, and there are 1,200 households, and parking ratio reaches 1:1, and there are eight layer of 11-33 small high, tall buildings and three urban mansion-style villa. Kindu Palace, as the 3A assessment system of the Ministry of Construction of residential housing properties, is the Chinese gold medal-building pilot living environment, and is construction ministry's demonstration residential building of energy efficiency, and is construction ministry's first green building certification program. Gold River project in Tai Yue real estate, was approved one of the "top ten key energy conservation projects" by the Ministry of Construction. The architectural planning design was made by Canadian UDS design companies, and the landscape design was made by Australian Five Bei international design company, and residential water features design was made by French filter Park Ltd, and the marketing plan was jointly made with Shenzhen black arc companies.

During the "eleventh five-year" period, Wuhan has made gratifying results in building energy efficiency, but there is a long way to go. According to preliminary statistics, there are nearly 300 million square meters existing buildings in Wuhan, of which 224 million square meters residential construction, and 50 million square meters public buildings. More than 95% buildings are high-energy buildings. Every year the new buildings cover 800 to 12 million square meters, and among them there are 10% energy saving building. In building energy consumption, the consumptions of heating and air conditioning account for 65%[3]. As the factors of the poor thermal performance of building envelope, long time of heating and cooling, the increasing popularity of air-conditioning, Wuhan's total building energy consumption compared to society's energy consumption is higher than the national average, reaching 35%, air-conditioning peak achieve 55.2% (excluding water storage air-conditioning). Building energy consumption of the city's energy supplies come under increasing pressure[4].

3. Countermeasures of Energy-saving Buildings in Wuhan City Circle during the "twelfth five-year" period

Building sustainable development is not only the challenge for built environment, construction equipment engineers, and is even more important challenge for architects. Saving energy and reducing energy consumption, should plan from the district and building, consider from the view of groups' permutations and combinations, and spent a lot of effort in the aspects of building orientation, shape, dimensions, layout, green, external structure (including outside walls, roof, doors, windows, etc.), new energy-saving materials and technology application. Use natural ventilation and natural light in the maximum extent, and introduce green into house.

3.1. Wall insulation and heat insulation

In the enclosure structure, the wall occupied the largest area. Wall heat transfer in winter and summer is 20 to 30% of the total construction heat transfer. Therefore, the external wall's insulation and heat insulation is critical. Wall reform plays an important role in energy saving building. Several places emerged around a number of new wall materials and effective thermal insulation materials, such as hollow clay brick, concrete hollow block, lightweight aggregate concrete, aerated concrete, polystyrene foam board, rock wool, mineral wool, glass wool, and polyurethane foam insulation inside the compound wall, the sandwich compound wall, external thermal insulation composite wall, etc.

Wall insulation and heat insulation not only to deal with the wall reform, more important is to take practical energy-saving measures. In domestic building's energy-saving projects, EPS, XPS application of external thermal insulation system is relatively the most mature, not only has a high thermal insulating properties, heat transfer coefficient K = 0.3 ~ 0.34W / (㎡ • K), thermal inertia index D = 2.5 ~ 2.6, but also has stable physical and mechanical properties, excellent waterproof performance . Application of these two wall insulation system can provide more favorable conditions for the external walls energy-saving and the indoor thermal comfort environment.

3.2. Low energy consumption of architectural windows and doors

The thermal properties of windows and doors have great influence on air-conditioning buildings' energy consumption, and are the key thermal design of winter and summer buildings. As the high heat transfer coefficient of windows and doors, and poor insulation, window heat gain per unit area is much higher than the wall, usually 5 to 20 times the wall. Outdoor hot and cold air also penetrate burglary through window cracks, and make glass window's heat occupies over 40% of the total envelope heat. The application of energy-saving building's windows and doors is an important component to ensure building energy conservation. We should consider the following aspects.

3.3. Use of energy-saving glass

The materials of energy-saving glass mainly have coated glass, insulating glass and heat-reflective material with a thin film of glass[6]. Coated glasses mainly include solar heat-reflective glass, Low-E glass and multi-coated glass. Such material has the greatest solar transmittance and the minimum reflection coefficient, allowing 80% of visible light into the room to be absorbed by the object, while the 90% of the long-wave radiation by indoor objects remain in the interior[5]. For example, the glass center area's heat transfer coefficient of super-vacuum glass made by Beijing New Liji Company reaches 0.93 W / (m^2.K); the glass center area's heat transfer coefficient of high-insulation glass reaches 1.02 W / (m^2.K)[6].

3.4. Development and application of Composite doors and windows dedicated materials

Focus on developing aluminum, steel, wood-plastic composite windows and doors' special materials and dedicated matching accessories and sealing materials. Such as PVC plastic of Japan YKKAP company, PVC profiles' thermal conductivity is only 0.17W / (m^2.K), that is much smaller than the thermal conductivity of metal profiles. Even add steel liner in the hollow cross section, the integrated heat transfer coefficient of the profile can achieve 2.0 W / (m^2.K)[7].

3.5. Improving installation of windows and doors and curtain wall

Developing the integration energy-saving technologies of windows and doors and curtain wall structure and maintenance structure, improving wall's overall energy-saving should focus on solving windows and doors, curtain wall anchor and fill technology. For example, Swiggle warm side takes as sealing material of insulating glass edge. Swiggle warm side is a continuous strip of aluminum with a strip of metal segregation. Compared with conventional aluminum separate, the section width of separated aluminum is only 0. 3mm, and is much smaller than the section width of traditional separated aluminum (5mm). Thus it can significantly reduce the thermal conductivity of the glass edge, and improve overall heat transfer coefficient of insulating glass (about 5%).

3.6. Roof insulation and heat insulation

The capacity of roof insulation and heat insulation is the most worthy of concern. The overheated room caused by strong solar radiation is a very common problem, and it must be taken seriously. The common roof insulation and heat insulation measures are as follows: roof ventilation, insulation and eco-sandwich-type building roof insulation technology[8]. The second measure is green buildings, which is consistent with national sustainable development strategy, and the most development potential building insulation technology. It turns out that the lawn roof can keep the room comfortable, and reduce air conditioning energy consumption, and increase urban green space, and reduce the content of CO_2 in the air, and improve ecological conditions.

3.7. Strengthening building energy conservation technology development efforts

Strengthening the research of energy-saving materials and energy technology, provides technical support for the building energy. Focus on promotion of external wall insulation system, energy-saving windows technology, roof insulation, solar energy and building integration technology, ground source heat pump and water source heat pump technology, residential central heating technology, solar lawn light, solar street lamps and other energy-saving building new technologies. Actively introduce and learn from international mature technology, system, and use advanced technology to push ahead of developed countries building energy efficiency. Continue to provide support to energy-saving technologies, energy-saving materials research and development from the aspects of fund and policy.

3.8. Establishment and implementation of building energy management

Establish and implement building energy-saving "design - Special Review - Design for the record - a special inspection - Energy acceptance," closed management procedures. Design documents must meet the mandatory provisions of state building energy conservation, and construction drawing review body should conduct a special review of the design file. If it can not reach "energy efficiency standards", it

shall not issue a certificate of construction drawing review, and can not undocumented construction. The construction project whose construction drawing is passed, should be informed recorded in the city office of building energy efficiency. At the same time, construction unit must follow the approval of the construction plans for the construction, and construction unit must follow the approval of the construction plans for the construction, and supervision units must follow the construction drawing design files to supervise. If that does not meet the requirements, it shall be ordered to correct. Building energy conservation office shall take single test in the main completed and completed stages. If that does not meet energy requirements, it shall be ordered to rectify. After the house is completed, when the construction unit check it, they should check the building energy efficiency target achievement. Inspection reports should recorded by construction quality department. If the record has not been inspected or fail to energy conservation standard, it shall not apply for final acceptance procedures.

4. Conclusions

In China, the government gives full attention to building energy efficiency, and introduces some policies and regulations that are helpful for save energy. Building energy conservation work has made some progress, but building energy efficiency is a project that calls for the government and the community work together to be successful. Because China's energy situation is more complex and technology development and applications have just started, and learning from successful experiences abroad are not enough, thus building energy efficiency work is still long way to go.

Acknowledgements

Project Support: Hubei science and technology plan natural science fund（NO：2010CDZ001）; Research funded project of Hubei Construction Department (2010-210-36); Wuhan Polytechnic University scientific research projects.

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